FORUM ARTICLE

Is the amount and focus of ecological research in New Zealand sufficient to sustain indigenous biodiversity on private land?

David A. Norton
Conservation Research Group, School of Forestry, University of Canterbury,
Private Bag 4800, Christchurch, New Zealand (E-mail: d.norton@fore.canterbury.ac.nz)

Abstract: By summarising ecological publications over the last 30 years, this paper provides an assessment of the amount and focus of New Zealand ecological research with respect to land tenure. While the number of published articles that deal with private land has increased over the last 30 years, the majority of New Zealand ecological research publications (65%) still focuses on public conservation lands, despite these only accounting for *c.* 30% of the land area. Even with the increasing emphasis in ecological research on private land there is still a need to better understand both the distribution of indigenous biodiversity and the interactions that occur between land management and indigenous biodiversity on private land. Such research is essential if we are to sustain indigenous biodiversity in lowland New Zealand.

Keywords: biodiversity conservation; ecological publications; lowlands; private land.

Introduction

With around 30% of its land area within the public conservation estate, New Zealand has the fifth highest area of protected land (IUCN protected area categories I-VI) and highest area of national park among the 29 OECD nations (OECD, 1997). While these figures are impressive, they hide the bias towards upland mountainous areas and the relatively poor protection of lowland areas within New Zealand conservation lands. For example, less than 20% of lands below 500 m are part of the public conservation estate, while some 50% of lands above 500 m are within it (Department of Conservation, *unpubl.).* The reasons for this upland-lowland imbalance are well known and result from the high value that lowland environments have for productive (economic) activities such as agriculture and plantation forestry (Mark, 1985; Norton, 1999). However, some ecosystem types have been almost lost from New Zealand as a result. For example, in the Waikato the area of lowland wetlands remaining in 1976 was only 16% of that present in 1840 (Groombridge, 1992). Even in regions with a relatively high proportion of conservation land such as the West Coast, lowland ecosystems are amongst the most disturbed by human activities. For example, by 1996 only 12% of the original area of lowland alluvial forest and wetlands remained in the Brunner Ecological District (D.A. Norton, *unpubi.),* a region otherwise well endowed with conservation land. These imbalances are of course not unique to New Zealand - they occur in many other parts of the world (Pressey and Tully, 1994; Chatelain *et al.,* 1996).

The importance of private land[1] for nature conservation has been recognised in a number of recent government initiatives: National laws such as the Resource Management Act 1991 and Forests Amendment Act 1993 place an onus on government to consider conservation as well as economic values in land-use planning in these areas, and the *New Zealand Biodiversity Strategy* (Anon, 2000a) and the reports of the Ministerial Advisory Committee, *Bio- What?* (Kneebone *et al.,* 2000) and *Biodiversity and Private Land* (Anon 2000b), emphasise the importance of biodiversity conservation on private land. These parliamentary acts and government reports represent a significant shift in conservation thinking away from the tradition of legally and administratively separating public conservation lands and values held about these lands from private lands and

[1] Private land is defined as "all land other -than that held and managed by the Crown for conservation purposes (includes the management of public land held predominantly for non-conservation purposes)" (Kneebone *et al.,* 2000).

values. The newer approach recognises the importance of better integrating these two value sets within the same landscape (Norton and Miller, 2000). This shift does not imply that we should open up conservation land to productive uses such as forestry or grazing, which are generally prohibited under New Zealand legislation anyway. Rather, it acknowledges that on non-conservation land we need to recognise the legitimate rights of land owners and managers to obtain an economic return from the land while at the same time sustaining indigenous biodiversity values (Knight, 1999; Norton, 2000).

There is a growing awareness of the importance of areas outside protected natural area systems for nature conservation world-wide. This is most obvious in countries that, like New Zealand, have been relatively recently settled by people of European origin, notably in the United States (Hunter, 1990; Knight, 1999) and Australia (Hobbs and Saunders, 1993; Morton *et al.,* 1995; Hale and Lamb, 1997; Craig *et al.,* 2000). However, in many European countries the distinction between conservation and production is less clear and biodiversity conservation already occurs over a wide range of land tenures (Sutherland and Hill, 1995).

The recent legislative developments provide some exciting opportunities for biodiversity conservation on private land in New Zealand. However, if we are to sustain indigenous biodiversity within these areas we need a good understanding of ecological processes in the highly modified ecosystems that dominate private land. By summarising ecological publications by ecologists working in New Zealand over the last 30 years, I provide an assessment of the focus of New Zealand ecological research with respect to land tenure in terrestrial and freshwater ecosystems.

Methods

Twenty-four scientific journals, 10 published in New Zealand and 14 overseas, were surveyed (Table 1). Although the journal coverage is not exhaustive, it does include the major peer-reviewed ecological journals used by New Zealand ecologists working in terrestrial and freshwater ecosystems. The choice of journals was slightly biased towards those concerned with biodiversity conservation as this was the underlying rationale for the study. For three 10-year time periods, 1968-77, 1978-87 and 1988-97, all issues of these journals were searched and three pieces of information recorded about each article concerned with New Zealand ecology:

Land tenure: Each article was scored as primarily focused on (i) public conservation land (including areas of indigenous vegetation managed by the former NZ Forest Service for non-timber values), (ii) private lands (e.g., agricultural, horticultural, plantation forests and urban), or (iii) a mixture of both. Aquatic ecosystems were scored based on the predominant surrounding land use.

Table 1. Ecological journals reviewed in the survey of articles.

New Zealand journals
- Journal of the Royal Society of New Zealand
- New Zealand Journal of Botany
- New Zealand Journal of Ecology (incl. Proceedings of the New Zealand Ecological Society)
- New Zealand Journal of Forestry (incl. New Zealand Forestry)
- New Zealand Journal of Marine and Freshwater Research
- New Zealand Journal of Zoology
- New Zealand Natural Sciences (incl. Mauri Ora)
- Notornis
- Tane
- Tuatara

Overseas journals
- Australian Journal of Ecology
- Biological Conservation
- Conservation Biology
- Ecology
- Freshwater Biology
- Functional Ecology
- Journal of Animal Ecology
- Journal of Applied Ecology
- Journal of Biogeography
- Journal of Ecology
- Journal of Vegetation Science
- Oceologia
- Vegetatio
- Wildlife Research (incl. Australian Wildlife Research)

Species origin: Articles were then scored on whether they focused primarily on (i) indigenous species, (ii) non-indigenous (exotic) species, or (iii) a mixture of both.

Taxonomic group: Articles were scored depending on whether their primary focus was on (i) plants (including fungi), (ii) vertebrate animals, (iii) invertebrate animals or (iv) a mixture of these.

Articles that were not primarily ecological, including papers on taxonomy and production management (e.g., silviculture of indigenous forests) were not included. All articles written by ecologists working in New Zealand were considered. The decisions on which papers to include and the scores assigned to each paper were of course subjective to some degree. Despite this subjectivity, the summary data provide an interesting overview of the focus of ecological research in New Zealand with respect to land tenure over the last three decades.

Results

A total of 1311 articles were reviewed, with 84% published in New Zealand journals and 16% in overseas journals. Overall, ecological publications focused much more on

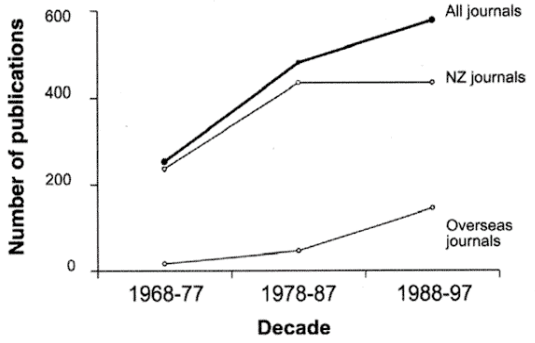

Figure 1. Number of New Zealand ecological articles published in journals over the last three decades.

public conservation land (65%) than on private land (19%). There was also a much stronger focus on indigenous species (53%) than on exotic species (27%), and the most common taxonomic groups studied were plants and vertebrate animals (74%).

The most obvious trend with time was the increasing number of ecological articles published, which more than doubled between the time periods 1968-77 and 1988-97 (from an average of 25 to 58 per year; Fig. 1). There was also an increasing trend towards publication in overseas journals over the three decades, with the ratio of papers published in New Zealand: overseas journals dropping from 14: 1 in 1968-77 to 3: 1 in 1988-97, and the number of articles published in New Zealand journals appearing to stabilise over the last two decades (Fig. 1).

While the number of papers that focused on different land tenures has increased for all three journal categories (Fig. 2), the proportion of papers that focused on private land increased slightly (18-20%) and the proportion that focused on public conservation land decreased slightly (68-64%). A similar pattern occurred with the taxonomic origin of species studied (Fig. 3) where the proportion focusing on indigenous species decreased (55-53%) and the proportion focusing on exotic species increased (23-28%). However, there were no obvious trends in the proportion of papers focusing on different taxonomic groups over the 30-year period.

An interesting pattern in the data was the change in relative focus of publications in New Zealand versus overseas ecological journals. In the decade 1968-77, New Zealand journals mainly published articles focused on public conservation lands (71 % of papers), with relatively few articles on mixed (13%) or private land tenures (16%). In contrast, publications in overseas journals were more evenly spread among these three categories (33, 28 and 39% respectively). However, by 1988-97, publications in New Zealand journals had become less heavily orientated towards public

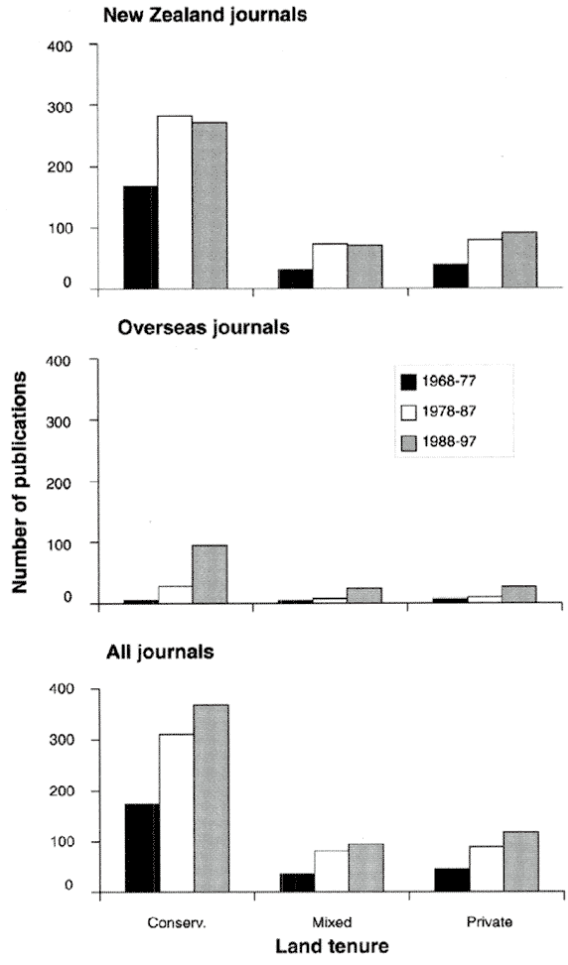

Figure 2. Number of New Zealand ecological anicles published in journals of different origins that focused primarily on public conservation land, on private lands or on a mixture of both.

conservation land (63, 16 and 21 % respectively) while publications in overseas journals were more heavily orientated towards studies focused on public conservation land (65, 17 and 18%).

Further analysis of papers based on land tenure (Table 2) shows the not unexpected result that those focusing on public conservation land were most concerned with native species (60%) and least with exotic species (18%). Those primarily involving private land showed the opposite pattern (32% native cf. 52% exotic). More interesting was the much greater emphasis on invertebrates in papers that focused on private and mixed land tenures (20 and 18% respectively), than on conservation land (10%). In contrast, research on plants and vertebrates was higher on public conservation land than private land,

although the highest proportion of studies focusing on vertebrates alone occurred on mixed land tenures (44%; Table 2).

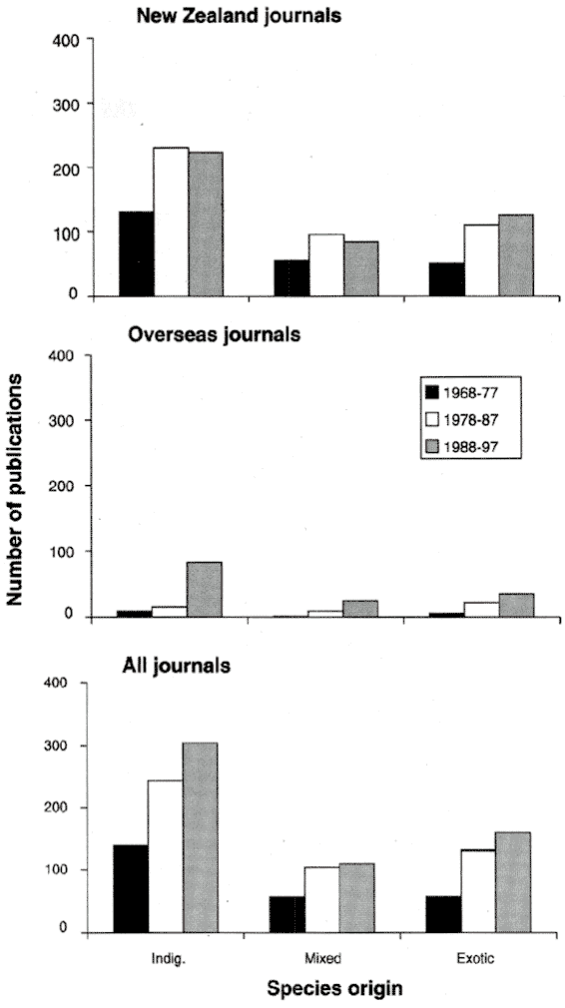

Figure 3. Number of New Zealand ecological articles published in journals of different origins that focused primarily on indigenous species, exotic species or on a mixture of both.

Discussion

The results presented here are to some degree dependent on the boundaries chosen for the literature search. While an attempt was made to cover the major journals in which New Zealand ecologists publish both nationally and internationally, some journals would have been missed. The inclusion of articles from those journals would obviously alter the frequencies cited above, but would .be unlikely to have altered the general patterns that emerged from the analysis. Also, this study did not consider the myriad of unpublished and published reports by ecologists, many of which are concerned with biodiversity issues on private land (e.g., significant natural area assessments). By and large, these reports are not peer reviewed so it is difficult to objectively decide on the ones to include in the assessment. Furthermore, the inaccessibility of many of these reports would have made it difficult to include a balanced or representative sample of them. However, as above, inclusion of these reports would be unlikely to have altered the overall trends identified in this paper, given the large number of reports concerned with biodiversity issues on public conservation land.

The results of this study highlight the predominant focus of New Zealand ecological research on public conservation land. This result is not unexpected. It reflects the importance of understanding the ecology of indigenous biodiversity within predominantly natural ecosystems if we are to sustain indigenous species in the long-term. Such an understanding is also fundamental to interpreting the ecology of indigenous biodiversity in the highly modified systems that characterise private land as it provides a benchmark from which to assess what is happening in these modified areas.

While the proportion of ecological publications focusing on private land was low compared to that for public conservation land (19 cf. 65%), there has been a slight trend towards an increasing emphasis on private land (18-20%) which suggests that. New Zealand ecologists are starting to shift their focus. There have been some excellent examples of biodiversity research relating to private lands and their management published in recent years (Clout and Gaze, 1984; Lord, 1990; Potter, 1990; Ogden *et. al.,* 1997; Harris and Bums, 2000) and recent conferences/symposia have also focused on

Table 2. Proportion of published New Zealand ecological articles by land tenure.

		Species origin (%)			Taxonomic group (%)			
Land tenure	No.	Native	Mixed	Exotic	Plant	Vert.	Invert.	Mixed
Conservation	850	60.4	21.5	18.1	41.8	35.5	10.0	12.7
Mixed	209	47.8	21.5	30.7	27.8	43.5	18.2	10.5
Production	252	31.7	16.7	51.6	30.6	33.7	19.8	15.9

this theme (Craig *et al.*. 2000; NZ Ecological Society 2000 Symposium). A similar recent emphasis of ecological research on private land has also occurred in Australia (Hobbs and Saunders. 1993; Saunders *et al.,* 1993; Hale and Lamb, 1997; Craig *et al.*. 2000).

Despite the increasing emphasis in ecological research on private land there is still a need to better understand both the distribution of indigenous biodiversity and the interactions that occur between land management and indigenous biodiversity on private land. While our understanding of remnant biota is improving (see above references), there are many key gaps in our knowledge. Issues where more ecological research is required include the effects of altered ecosystems processes (e.g., hydrology) on remnant biota (Hobbs, 1993), the way that indigenous species utilise the new mixed ecosystems that dominate lowland New Zealand (Potter, 1990), the role of introduced species as dispersers of both exotic and indigenous species (Williams and Karl, 1996), and the diversity of options that might be available to facilitate indigenous biodiversity and an economic return from the land (Norton, 1998; Norton and Miller, 2000).

It is important, however, to acknowledge that there are a number of barriers to conducting ecological research on private land (Susan Wiser, Landcare Research, Lincoln, N.Z., *pers. comm.),* many of which are not present on public conservation land. These barriers include uncertainty for long-term studies because of potential changes in land tenure, suspicion among landowners that research may reveal conservation values that will limit their ability to manage the land, and an unwillingness by landowners to allow information about their land to be passed onto third parties (especially government agencies). But there are also advantages in conducting research on private land. For example, there may be greater flexibility to experimentally manipulate systems and research equipment may be less likely to be vandalized or stolen.

The strong tradition of ecological research on public conservation land in New Zealand is not unique. It occurs in most other developed countries and can be traced, at least in part, to the many natural history programmes that focus on the 'charismatic and remote' which have helped shape recent generations of ecologists and conservation biologists. Working with remnant species in muddy fields amongst cows cannot match the appeal of working with a charismatic national icon in a remote wilderness area. Yet such research is essential if we are to sustain indigenous biodiversity in lowland New Zealand.

Acknowledgements

I thank Richard Earle and Sarah McElrea for assistance with the journal reviews, and Susan Wiser and an anonymous referee for constructive comments on the manuscript.

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